Effect of Activated Charcoal on Growth of *Curcuma longa* Linne

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ABSTRACT

This study was conducted to investigate the effect of Activated charcoal (AC) for stimulating growth and productivity of *Curcuma longa* Linne as affected by different concentrations of AC. Growth characteristics such as plant height and leaf length were the highest with the optimum amount of activated charcoal ranged from 10 to 30%. Root growth was elongated by the addition of 30% AC with the highest rhizome length and weight.

Key words **:** Activated charcoal, *Curcuma longa* Linne, quality, yield

INTRODUCTION

'Yulgeum'(*Curcuma longa* Linne), a perennial herbaceous plant of Zingiberaceae, is native to India and partly growing in Taiwan, Indonesia, and Japan. Leaves are big, 30-60 cm long, 10-20 cm wide, with sharp leaf tip, triangled leaf base, and green in the upper side. The species belongs to *Curcumi* genus as like *Curcumi aromatica* and has *rhizomes* with scents and yellow color in periderm (An, 2000). The rhizome of C. *aromatica* is thinner than ginger (*Zingiber officinalis* Rosc.), and thicker than *Zingiber moga* (Thun.) Roscoe. The rhizome is being utilized as a medicinal material, and its major compositions are known to be curcumin, p-methydol irucabinole, tumerone, azulene, kampfa.

Few studies on the cultural physiology and ecology of C. *longa* has conducted. Most recently, C. *longa* introduced from Okinawa, Japan in 1997 is growing at a farm of Jindo, Jeonnam. However, there are many difficulties in cultivating the species because of poor information and experience.

Many studies on the soil conditioner have conducted to enhance yield and quality of agricultural crops, especially in Japan. In Korea, researches on the soil modifier for improving productivity in crops are a increasingly field in organic agriculture and soil science (Park, 2000).

The utility of activated charcoal varies for multi-purposes environmental and agricultural areas. Especially, it will be utilized as a multi-pore carbon absorbant for protecting environmental contamination and as a soil modifying material for improving soil physical property and sustainable nutrient sources, through mixing with it into soil.

Recently, in Korea, 45,000 tons of activated charcoal per a year is required for protecting environmental

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substances including water and air contaminations. However, the waste of activated charcoal as a industrial abandon after using is increased every year.

Therefore, this study was conducted to develop recycling methods of the wasteful activated charcoal for agricultural cropping system and industrial areas. It would be very useful as a soil-modifyng material for enhancing crop productivity.

MATERIALS AND METHODS

Rhizomes with two-three sprouts (5cm long, 20g weight) of *Curcuma longa* Salisbury were transplanted at a pot (45cm × 45cm × 60cm) on April 20, 2002. At 2 weeks before transplanting, activated charcoal at 0, 10, 30, 50 and 70% were mixed with clay loam soil that sterilized with heat. All treatments were replicated five times using a randomized complete block design. All cultural management for C. *longa* followed standard methods for ginger from Rural Development Adminstration (RDA), Korea. During plant growth, the growing conditions were maintained near field capacity by sub-irrigation. Plant growth of all plants were determined 120 days after transplanting (August 20, 2002), and harvest for rhizome was made at 230 days after transplanting (December 10, 2002).

Emergence rate was determined after 3~5 weeks transplanting, plant height, leaf length, and leaf width were measured on September 25, and the rhizome was harvested on December 10, 2002. All measurements for plant growth and yield were referred to standard measurement of RDA, Korea (RDA, 1983).

RESULTS AND DISCUSSION

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When the charcoal was added into pot, effect of activated charcoal on topgrowth of *Curcuma longa* as affected by different amount was determined. The results on responses of emergence rate, plant height, leaf length and leaf width were shown Table 1.

Emergence of *Curcuma longa* was made on May 20 (30 days after transplanting), showing 83~88% in emergence rate. It is generally accepted that *Curcuma longa* have higher emergence rate and short emergence period when faced with high soil temperature (An, 2000).

Treatment of activated charcoal at 30% showed the highest plant height (135 cm) compared with control (115 cm) and followed by 10% AC (130 cm) treatment, 50% AC (112 cm) and 70% AC (110). The result suggests that optimum amount of activated charcoal was ranged from 10 to 30% for enhancing growth of C. *longa* due to increasing of water and nutrient holding capacities as well as improving soil physical property. Leaf length and width at 30% AC treatment were 43.5 and 16.5 cm while those at control was 42.5 and 17.8

Table 1. Effect of activated charcoal on the growth of *Curcuma longa*

Treatment	Emergence		Height of plant	Leave length	Leave width
	Date	Ratio(%)	(cm)	(cm)	(cm)
Control	May 20	83	115b[z]	42.5a	17.8a
Activated Charcoal 10%	May 19	85	130a	43.1a	17.9a
Activated Charcoal 30%	May 21	87	135a	43.5a	16.5a
Activated Charcoal 50%	May 21	88	112b	42.1a	17.0a
Activated Charcoal 70%	May 20	86	110b	42.0a	17.1a

[z]: Same alphabetical letters indicate no significant difference at 5% level of DMRT.

Table 2. Effect of activated charcoal on the growth characteristic of rhizome in *Curcuma longa*

Treatment	Rhizome ht.(mm)	Rhizome wt.(g/per plant)	Rhizome color
Control	720b[z]	971b	Olive brown
Activated Charcoal 10%	814a	990a	Yellowish brown
Activated Charcoal 30%	820a	995a	Yellowish brown
Activated Charcoal 50%	781ab	982ab	Yellowish brown
Activated Charcoal 70%	719b	970b	Olive brown

[z] : Mean separation within column by Duncan's multiple range test, 5% level of significance.

cm, respectively, showing a similar tendency to the topgrowth. However, no significant difference among treatments were observed.

Taking together, the results are supported by the report of Park (2000) who reported that optimized amount of AC stimulate crop growth by improving soil physical characteristics. Choi (2002), in another study, reported that treatment of AC around 20% improved the growth of medicinal plants, and exhibited differently depending on crop species

Effect of Activated Charcoal on Rhizome Growth of *Curcuma longa*

To determine the effect of AC on rhizome growth of C. *longa*, length and weight of rhizomes were measured on a plant (Table. 2)

In pot test, length of rhizome was ranged from 719mm to 820mm, and rhizome weight a plant from 960 to 995g when treated with AC. Rhizome length was significantly increased to 814~820mm comapred with control when treated with 10%~30% AC. AC at 30% increased rhizome weight by 990g per plant while control was 970g. However, no significant difference in weight was observed when treated with above 50% AC. As the results, it was thought that optimum amount of AC was ranged with 10%~30% and improved rhizome length and weight due to increasing water and nutrient holding capacities as well as physical properties of cultivated soil. This result supports the report that AC treated with optimum amount significantly can stimulate crop growth (Park, 2000).

On the other hand, color of rhizome coat was light to dark brown and not differ among treatment amounts.

These results require further more detail studies on effects of treatment methods on growth responses of *C. longa* as affected by different growing stages.

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